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Surveillance Summaries

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Malaria Surveillance --- United States, 2003

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Abstract

Problem/Condition: Malaria in humans is caused by any of four species of intraerythrocytic protozoa of the genus *Plasmodium* (i. e., *P. falciparum, P. vivax, P. ovale, or P. malariae*). These parasites are transmitted by the bite of an infective female *Anopheles* sp. mosquito. The majority of malaria infections in the United States occur among persons who have traveled to areas with ongoing transmission. In the United States, cases can also occur through exposure to infected blood products, by congenital transmission, or by local mosquitoborne transmission. Malaria surveillance is conducted to identify episodes of local transmission and to guide prevention recommendations for travelers.

Period Covered: This report covers cases with onset of illness in 2003, and summarizes trends over previous years.

Description of System: Malaria cases confirmed by blood film are mandated to be reported to local and state health departments by health-care providers or laboratory staff. Case investigations are conducted by local and state health departments, and reports are transmitted to CDC through the National Malaria Surveillance System (NMSS). Data from NMSS serve as the basis for this report.

Results: CDC received reports of 1,278 cases of malaria with an onset of symptoms in 2003, including seven fatal cases, among persons in the United States or one of its territories. This number represents a decrease of 4.4% from the 1,337 cases reported for 2002. *P. falciparum, P. vivax, P. malariae, and P. ovale* were identified in 53.3%, 22.9%, 3.6%, and 2.6% of cases, respectively. Twelve patients (0.9% of total) were infected by two or more species. The infecting species was unreported or undetermined in 212 (16.6%) cases. Compared with 2002, the number of reported malaria cases acquired in Asia (n = 177) and the Americas (n = 147) increased by 3.5% and 4.3% respectively, whereas the number of cases acquired in Africa (n = 840) decreased by 7.0%. Of 762 U. S. civilians who acquired malaria abroad, 132 (17.3%) reported that they had followed a chemoprophylactic drug regimen recommended by CDC for the area to which they had traveled. Ten patients became infected in the United States, including one probable transfusion-related, one in which epidemiologic investigations failed to identify any apparent mode of acquisition, and eight which were introduced cases as a result of local mosquitoborne transmission. Of the seven deaths attributed to malaria, five were caused by *P. falciparum*, and a species was not identified in the other two.

Interpretation: The 4.4% decrease in malaria cases in 2003, compared with 2002, resulted primarily from a decrease in cases acquired in Africa, but this decrease was offset by an increase in the number of cases acquired in the Americas and Asia. This small decrease probably represents year-to-year variation in malaria cases, but also could have resulted from local changes in disease transmission, decreased travel to malaria-endemic regions, or fluctuation in reporting to state and local health departments. In the majority of reported cases, U.S. civilians who acquired infection abroad were not on an appropriate chemoprophylaxis regimen for

the country in which they acquired malaria.

Public Health Actions: Additional information was obtained concerning the seven fatal cases and the 10 infections acquired in the United States. Persons traveling to a malarious area should take one of the recommended chemoprophylaxis regimens appropriate for the region of travel, and travelers should use personal protection measures to prevent mosquito bites. Any person who has been to a malarious area and who subsequently experiences a fever or influenza-like symptoms should seek medical care immediately and report their travel history to the clinician; investigation should include a blood-film test for malaria. Malaria infections can be fatal if not diagnosed and treated promptly. Recommendations concerning malaria prevention can be obtained from CDC by calling the Malaria Hotline at 770-488-7788 or by accessing CDC's Internet site at http://www.cdc.gov/travel. Recommendations concerning diagnosis of malaria and its treatment can be obtained by calling the Malaria Hotline or accessing CDC's Internet site at http://www.cdc.gov/malaria/diagnosis_treatment/treatment.htm.

Introduction

Malaria is caused by infection with one or more of four species of *Plasmodium* (i.e., *P. falciparum, P. vivax, P. ovale, and P. malariae*) that can infect humans. Other *Plasmodium* species infect animals. The infection is transmitted by the bite of an infective female *Anopheles* sp. mosquito. Malaria infection remains a devastating global problem, with an estimated 300--500 million cases occurring annually (*1*). Forty-one percent of the world's population lives in areas where malaria is transmitted (e.g., parts of Africa, Asia, the Middle East, Central and South America, Hispaniola, and Oceania) (*1*), and 700,000--2.7 million persons die of malaria each year, 75% of them African children (*2*). Before the 1950s, malaria was endemic throughout the southeastern United States; an estimated 600,000 cases occurred in 1914 (*3*). During the late 1940s, a combination of improved housing and socioeconomic conditions, water management, vector-control efforts, and case management was successful at interrupting malaria transmission in the United States. Since then, malaria case surveillance has been maintained to detect locally acquired cases that could indicate the reintroduction of transmission and to monitor patterns of antimalarial drug resistance. Anopheline mosquitos remain seasonally present in all states and territories except Guam and Hawaii.

The majority of reported cases of malaria each year diagnosed in the United States have been imported from regions of the world where malaria transmission is known to occur, although congenital infections and infections resulting from exposure to blood or blood products are also reported in the United States. In addition, a limited number of cases are reported that might have been acquired through local mosquitoborne transmission (*4*), typically <1% per year.

State and local health departments and CDC investigate malaria cases acquired in the United States, and CDC analyzes data from imported cases to detect trends in acquisition. This information is used to guide malaria-prevention recommendations for international travelers. For example, an increase in *P. falciparum* malaria among U.S. travelers to Africa, an area with increasing chloroquine resistance, prompted CDC to change the recommended chemoprophylaxis regimen from chloroquine to mefloquine in 1990 (*5*).

The signs and symptoms of malaria illness are varied, but the majority of patients experience fever. Other common symptoms include headache, back pain, chills, sweating, myalgia, nausea, vomiting, diarrhea, and cough. The diagnosis of malaria should be considered for persons who experience these symptoms and who have traveled to an area with known malaria transmission. Malaria should also be considered in the differential diagnoses of persons who experience fevers of unknown origin, regardless of their travel history. Untreated *P. falciparum* infections can rapidly progress to coma, renal failure, pulmonary edema, and death. Asymptomatic parasitemia can occur, most commonly among persons who have been long-term residents of areas where malaria is endemic. This report summarizes malaria cases reported to CDC with onset of symptoms in 2003.

Methods

Data Sources

Malaria case data are reported to the National Malaria Surveillance System (NMSS) and the National Notifiable Diseases Surveillance System (*6*). Although both systems rely on passive reporting, the numbers of reported cases might differ because of differences in collection and transmission of data. A substantial difference in the data collected in these two systems is that NMSS receives more detailed clinical and epidemiologic data about each case (e.g., information about the area to which the infected person has traveled). This report presents only data about cases reported to NMSS.

Cases of blood-film--confirmed malaria among civilians and military personnel are identified by health-care providers or laboratories. Each slide-confirmed malaria case is reported to local or state health departments and to CDC on a uniform case report form that contains clinical, laboratory, and epidemiologic information. CDC staff review all report forms when received and request additional information from the provider or the state, if necessary (e.g., when no recent travel to a malarious country is reported). Reports of other cases are telephoned to CDC directly by health-care providers, usually when they are seeking assistance with diagnosis or treatment. Cases reported directly to CDC are shared with the relevant state health department. All cases that have been acquired in the United States are investigated, including all induced and congenital cases and possible introduced or cryptic cases. Information derived from uniform case report forms is entered into a database and analyzed annually. U.S. military and civilian cases diagnosed outside of the United States and its territories are not reported through this system and are not included in this report.

Definitions

The following definitions are used in this report:

- **Laboratory criteria for diagnosis:** Demonstration of malaria parasites on blood film.
- **Confirmed case:** Symptomatic or asymptomatic infection that occurs in a person in the United States who has microscopically confirmed malaria parasitemia, regardless of whether the person had previous episodes of malaria while in other countries. A subsequent episode of malaria is counted as an additional case if the indicated *Plasmodium* sp. differs from the initially identified species. A subsequent episode of malaria occurring in a person while in the United States could indicate a relapsing infection or treatment failure resulting from drug resistance if the indicated *Plasmodium* sp. is the same species identified previously.

This report also uses terminology derived from the recommendations of the World Health Organization (7). Definitions of the following terms are included for reference:

- **Autochthonous malaria:**
  --- **Indigenous.** Mosquitoborne transmission of malaria in a geographic area where malaria occurs regularly.
  --- **Introduced.** Mosquitoborne transmission of malaria from an imported case in an area where malaria does not occur regularly.
- **Imported malaria:** Malaria acquired outside a specific area. In this report, imported cases are those acquired outside the United States and its territories (Puerto Rico, Guam, and the U.S. Virgin Islands).
- **Induced malaria:** Malaria acquired through artificial means (e.g., blood transfusion or by using shared common syringes).
- **Relapsing malaria:** Renewed manifestations (i.e., clinical symptoms or parasitemia) of malarial infection that is separated from previous manifestations of the same infection by an interval greater than the usual periodicity of the paroxysms.
- **Cryptic malaria:** A case of malaria where epidemiologic investigations fail to identify a plausible mode of acquisition (this term applies mainly to cases identified in countries where malaria is not endemic).

Microscopic Diagnosis of Malaria

The early and prompt diagnosis of malaria requires that physicians obtain a travel history from every febrile patient. Malaria should be included in the differential diagnosis of every febrile patient who has traveled to an area where malaria is endemic. If malaria is suspected, a Giemsa-stained film of the patient's peripheral blood should be examined for parasites. Thick and thin blood films must be prepared correctly because diagnostic accuracy depends on blood-film quality and examination by experienced laboratory personnel* (Appendix).

Results

General Surveillance

For 2003, CDC received 1,278 malaria case reports occurring among persons in the United States and its territories, representing a 4.4% decrease from the 1,337 cases reported with a date of onset in 2002 (*8*) (Table 1). In 2003, a total of 767 cases occurred among U.S. civilians and 306 cases among foreign civilians (Table 1). In recent years, cases among U.S. civilians have increased and cases among foreign-born civilians have decreased (Figure 1). These trends are probably a result of increased travel among U.

S. citizens and decreased immigration since 2001.

Plasmodium Species

The infecting species of *Plasmodium* was identified in 1,066 (83.4%) of the cases reported in 2003. *P. falciparum* and *P. vivax* were identified in blood films from 53.4% and 22.9% of infected persons, respectively (Table 2). The 682 *P. falciparum* cases reported for 2003 represented a 2.4% decrease from the 699 cases in 2002, and the number of *P. vivax* infections decreased by 13.6% (from 339 in 2002 to 293 in 2003). Among 1,015 cases in which both the region of acquisition and the infecting species were known, 83.5 % of infections acquired in Africa were attributed to *P. falciparum*; 7.0% were attributed to *P. vivax*. The converse was true of infections acquired in the Americas and Asia: 62.9% and 80.4% were attributed to *P. vivax*, and 31.5% and 12.0% were attributed to *P. falciparum*, respectively.

Region of Acquisition and Diagnosis

All but 10 reported cases (n = 1,268) were imported. Of 1,201 imported cases in which the region of acquisition was known, the majority (70.0%; n = 840) were acquired in Africa; 14.7 % (n = 177) and 12.3% (n = 147) were acquired in Asia and the Americas, respectively (Table 3). A limited number of imported cases were acquired in Oceania (3.1%; n = 37). The highest concentration of cases acquired in Africa came from countries in West Africa (67.5%; n = 567); a substantial percentage of cases acquired in Asia came from the Indian subcontinent (56.5%; n = 100). From within the Americas, the majority of cases were acquired in Central America and the Caribbean (63.9%; n = 94), followed by South America (21.8%; n = 32) and Mexico (14.3% n=21). Information about region of acquisition was missing for 67 (5.3%) of the imported cases.

Compared with 2002, the number of reported malaria cases acquired in Asia and the Americas increased by 3.5% and 4.3% respectively, and the number of cases acquired in Africa decreased 7.0%.

In the United States, the six health departments reporting the highest number of malaria cases were New York City (n = 191), California (n = 155), Florida (n = 86), Maryland (n = 73), Georgia (n = 68), and New York State (n = 68) (Figure 2). The majority of these health departments reported a decrease in cases compared with 2002, consistent with the overall decrease in cases occurring nationwide. This decrease probably represents year-to-year variation in malaria cases rather than a trend, but could also have resulted from local changes in disease transmission abroad, decreased travel to malaria-endemic regions, or fluctuation in reporting to state and local health departments.

Interval Between Arrival and Illness

The interval between date of arrival in the United States and onset of illness and the infecting *Plasmodium* species was known for 640 (50.5 %) of the imported malaria cases (Table 4). Symptoms began before arrival in the United States for 77 (12.0%) persons, and symptoms began after arrival in the United States for 563 (88.0%) persons. Clinical malaria occurred within 1 month after arrival in 363 (79.4%) of the 457 persons with *P. falciparum* cases and in 57 (42.2%) of the 135 persons with *P. vivax* cases (Table 4). Only five (0.8%) of the 640 persons became ill >1 year after returning to the United States.

Imported Malaria Cases

Imported Malaria Among U.S. Military Personnel

In 2003, a total of 36 cases of imported malaria was reported among U.S. military personnel. These cases were reported by state health departments. Of these, 28 (77.8%) had been acquired in Asia, five (13.9%) in the Americas, two (5.6%) in Africa, and one (2.8%) in Oceania. This is similar to the distribution of cases in 2002.

Imported Malaria Among Civilians

A total of 1,066 imported malaria cases were reported among civilians. Of these, 761 (71.4%) occurred among U.S. residents, and 305 (28.6%) cases occurred among residents of other countries (Table 5). Of the 761 imported malaria cases among U.S. civilians, 561 (73.7%) had been acquired in Africa, a decrease of 12.5% from cases reported in 2002. Asia accounted for 83 (10.9%) cases of imported malaria among U.S. civilians, and travel to the Central American and Caribbean regions accounted for 59 (7.6%) cases.

Of the 305 imported cases among foreign civilians, the majority of cases were acquired in Africa (n = 202; 66.2%).

Antimalarial Chemoprophylaxis Use

Chemoprophylaxis Use Among U.S. Military Personnel

Information about chemoprophylaxis use and travel area was known for 33 (91.7%) of the 36 U.S. military personnel who had imported malaria. Of these 33 persons, eight (24.2%) were not using any chemoprophylaxis, two (6.1%) had not taken a CDC-recommended drug for the area visited, and 23 (69.7%) took a CDC-recommended medication. Of the 23 U.S. military personnel who took a CDC-recommended medication for the area visited, 10 (43.5%) reported taking doxycycline daily, two of those in combination with primaquine for terminal prophylaxis; seven (30.4%) had taken mefloquine weekly, one in combination with primaquine; four (17.4%) who had traveled to areas where chloroquine-resistant malaria has not been documented had taken chloroquine weekly, three in combination with primaquine; none had taken atovaquone-proguanil; and two (8.7%) had taken a combination of drugs that included more than one CDC-recommended medication for the travel region.

Chemoprophylaxis Use Among U.S. Civilians

Information about chemoprophylaxis use and travel area was known for 709 (93.2%) of the 761 U.S. civilians who had imported malaria. Of these 709 persons, 445 (62.8%) had not taken any chemoprophylaxis, and 111 (15.7%) had not taken a CDC-recommended drug for the area visited (*9*). Only 132 (18.6%) U.S. civilians had taken a CDC-recommended medication (*9*). Data for the specific drug taken were missing for the remaining 21 (3.0%) travelers. A total of 85 (64.4%) patients on CDC-recommended prophylaxis had reported taking mefloquine weekly; 35 (26.5%) had taken doxycycline daily; none had taken atovaquone-proguanil daily; and five (3.8%) who had traveled only in areas where chloroquine-resistant malaria has not been documented had taken chloroquine weekly. Information about adherence to the drug regimen for these persons is presented in the following section. Seven patients (5.3%) had taken combinations of drugs that included one or more CDC-recommended drug for the travel region. Of the 111 patients taking a nonrecommended drug, 47 (42.3%) reported taking chloroquine either alone or in combination with another ineffective drug during travel to an area where chloroquine resistance has been documented.

Malaria Infection After Recommended Prophylaxis Use

A total of 167 patients (132 U.S. civilians, 23 persons in the U.S. military, six foreign civilians, and six persons whose information about their status was missing) contracted malaria after taking a recommended antimalarial drug for chemoprophylaxis. Of these, 58 (34.7%) reported compliance with the regimen, 79 (47.3%) reported noncompliance, and compliance was unknown for the remaining 30 (18.0%). Information about infecting species was available for 131 (78.4%) patients taking a recommended antimalarial drug; the infecting species was undetermined for the remaining 36.

Cases of *P. vivax* or *P. ovale* After Recommended Prophylaxis Use. Of the 167 patients who had malaria diagnosed after recommended chemoprophylaxis use, 65 (38.9 %) had cases that were caused by *P. vivax* and three (1.8%) by *P. ovale*.

A total of 18 (26.5%) cases of *P. vivax* or *P. ovale* occurred >45 days after arrival in the United States. These cases were consistent with relapsing infections and do not indicate primary prophylaxis failures. Information was insufficient because of missing data about symptom onset or return date to assess whether 34 cases were relapsing infections. Sixteen cases, 15 by *P. vivax* and one by *P. ovale*, occurred <45 days after the patient returned to the United States. Nine of the 16 patients were known to be noncompliant with their antimalarial chemoprophylaxis regimen. Four patients reported compliance with an antimalarial chemoprophylaxis regimen. Of these four, one had traveled to Asia, one to sub-Saharan Africa, and two to South America. One of these patients reported taking mefloquine and three reported using doxycycline. Blood samples for serum drug levels were not available for these four patients. The possible explanations for these cases include inappropriate dosing, noncompliance that was not reported, malabsorption of the drug, or emerging parasite resistance. For the remaining three patients, no information was available about compliance. The region of acquisition varied for these three patients (one from Ethiopia, one from Mexico, and one from Papua New Guinea).

Cases of *P. falciparum* and *P. malariae* after Recommended Prophylaxis Use. The remaining 99 cases of malaria reported among persons who had taken a recommended antimalarial drug for chemoprophylaxis include 54 cases of *P. falciparum*, six cases of *P. malariae*, three cases of mixed infection, and 36 cases in which the infecting species was unidentified.

A total of 52 of the 54 *P. falciparum* cases among those who reported taking a recommended antimalarial drug were acquired in Africa and two in South America. In 33 (61.1%) of these 54 cases, noncompliance with antimalarials was reported. In 14 (26.0%) of these 54 cases, patients reported compliance with antimalarial chemoprophylaxis. All 14 of these patients had traveled to Africa. Thirteen had reported taking mefloquine, and one had reported taking doxycycline for malaria chemoprophylaxis. Blood samples were not available for the 14 patients who reported compliance with a recommended regimen. Seven cases of *P. falciparum* were identified for which patient compliance was unknown.

Five of the six *P. malariae* cases among those who reported taking a recommended antimalarial drug were acquired in Africa. Two (40.0%) of these patients reported noncompliance with antimalarials, and two (40.0%) patients reported compliance with a recommended chemoprophylaxis regimen. One of the compliant patients had used doxycycline and the other one used mefloquine; one had traveled to Africa and one to Asia and blood samples were not available.

Purpose of Travel

Purpose of travel to malaria-endemic areas was reported for 692 (90.9%) of the 761 U.S. civilians with imported malaria (Table 6). Certain cases reported more than one purpose of travel. Of the U.S. civilians with malaria, the largest proportion (53.9%) was persons who had visited friends or relatives in malarious areas; the second and third highest proportion, 12.5% and 9.2%, had traveled for tourism and to do missionary work, respectively.

Malaria During Pregnancy

A total of 31 cases of malaria were reported among pregnant women in 2003, representing 7.0% of cases among women. Eighteen of the 31 (58.1%) were among U.S. civilians; all 18 had traveled to Africa and 14 of the 18 women had traveled to visit friends and relatives. Of the remaining 13, a total of 12 were foreign civilians. Approximately 13% of pregnant women and 28.2% of nonpregnant women reported taking malaria chemoprophylaxis.

Malaria Acquired in the United States

Cryptic Malaria

One case of cryptic malaria was reported in 2003 and is described in the following case report:

- **Case 1.** On August 7, 2003, a female aged 14 years from Maryland with a history of cerebral palsy was admitted for 4 days to a local hospital for work up of fever. No source was identified, and the patient was discharged but returned to another hospital the following day with persistent fever and was admitted. Six days after admission, the patient had a peripheral blood smear that was positive for *P. falciparum* with a 12% parisitemia. The patient was anemic and thrombocytopenic. She was treated successfully with intravenous (IV) quinidine and doxycycline. The patient had no history of recent travel or transfusion, but had been hospitalized during July 14--August 1, 2003, for placement of a surgical feeding tube. During that hospital stay, she shared a pediatric intensive care unit room with a boy aged 9 years who was being treated for *P. falciparum*, presumably acquired on a recent trip to Gambia. They shared the room for <24 hours on July 22, 2003. No needle-stick injuries, transfusions, or common infusions were reported.

Induced Malaria

One case of induced malaria, caused by blood transfusion, was reported in 2003 and is described in the following case report:

- **Case 1.** On March 31, 2003, a man aged 69 years from Texas was admitted to a local hospital with severe hypertension and acute renal failure. Three days after admission, the patient had upper gastrointestinal bleeding (hemoglobin: 6.9 mg/dL) and was transfused with two units of packed red blood cells (PRBCs). The patient reported having had no other blood transfusions during the 12 months preceding hospitalization. The patient was started on hemodialysis and discharged on April 12. On April 19, the patient experienced fever, diarrhea, and mental confusion. He went to the emergency department 3 days later with fever (101.4°F [38.5°C]), lethargy, and altered mental status, and was admitted to the intensive care unit (ICU). Blood cultures and cerebrospinal fluid testing did not reveal the presence of a bacterial pathogen. Blood smears demonstrated *P. falciparum*. The patient was started on IV quinidine and doxycycline and discharged after 21 days. The

patient was retired, spent the majority of his time indoors, denied IV drug use, and last traveled outside of his home town in 1995 to Laredo, Texas. The Texas Department of Health, in collaboration with CDC and the local blood collection center, conducted a donor traceback investigation of the two units of PRBCs used for the patient's transfusions. The investigation determined that one donor was a Ghanian man aged 18 years who had immigrated to Houston in May 2002. His mother reported that her son had been treated for malaria in Ghana 2 years earlier. Blood smear examination and polymerase chain reaction (PCR) performed on the specimen from the Ghanaian donor were negative for the presence of malaria parasites or parasite DNA. However, serology using indirect immunofluoresence antibody (IFA) testing demonstrated elevated titers of antibodies to malaria (1:256 for *P. falciparum*, 1:64 for *P. malariae*, 1:64 for *P. ovale*, and 1:64 for *P. vivax*), indicating previous malaria infection at an indeterminate time.

Introduced Malaria

Eight cases of introduced malaria were reported in 2003 (*10*). The cases occurred in Palm Beach County, Florida, and PCR demonstrated the same strain for all eight cases. They are described in the following case reports:

- **Case 1.** On July 22, a man aged 46 years reported to the emergency department (ED) of hospital A with a 3-day history of fever, headache, chills, anorexia, nausea, vomiting, dehydration, and malaise. He was treated with IV fluids and discharged on levofloxacin. On July 24, he returned to the ED with worsening symptoms and was admitted with a diagnosis of pneumonia. On July 25, *P. vivax* was identified on a blood smear, which was later confirmed by PCR. The patient recovered after treatment with doxycycline, quinine, and primaquine. The patient denied blood transfusion, IV drug use, or travel to any malarious regions during the preceding 12 months. The patient is a construction worker who reported working outside.
- **Case 2.** On July 24, a man aged 37 years was admitted to hospital A with a 6-day history of fever, chills, headache, anorexia, and vomiting. On July 25, *P. vivax* was identified on a blood smear, which was confirmed by PCR. The patient recovered after treatment with doxycycline, quinine, and primaquine. The patient had no history of blood transfusions or IV drug use, and his only travel during the preceding 12 months had been to the Bahamas during June 28--July 2, 2003. The patient is a plumber who reported working outside during the day but who stayed indoors at night.
- **Case 3.** On August 15, a man aged 32 years was admitted to hospital A with a 33-day history of fever, chills, headache, vomiting, and intermittent sweating. He had consulted multiple physicians for his symptoms and had been treated unsuccessfully with azithromycin and prednisone. On the day of admission, *P. vivax* was identified on a blood smear, which was later confirmed by PCR. The patient fully recovered after treatment with doxycycline, quinine, and primaquine. The patient denied blood transfusions or IV drug use, and his only other travel during the preceding 12 months was to the Bahamas in May 2003. He reported having played golf and tennis in the evenings.
- **Case 4.** On August 19, a man aged 45 years visited the ED of hospital A with a 2-day history of fever, chills, anorexia, arthralgias, and diarrhea and was discharged on ibuprofen. The patient returned to the ED on August 21 for these same symptoms, was evaluated, and discharged. On August 22, he returned again with worsening symptoms and mental confusion and was admitted. A blood smear demonstrated the presence of *P. vivax*, which was later confirmed with PCR. The patient was treated with chloroquine and primaquine and recovered. The patient denied ever having traveled to a malarious area, IV drug use, or history of blood transfusion during the preceding 12 months. The patient slept in a homeless camp in a wooded area near a canal.
- **Case 5.** On August 24, a man aged 23 years was admitted to hospital A with a 12-day history of fever, chills, arthralgias, diarrhea, and vomiting. A blood smear demonstrated the presence of *P. vivax*, which was later confirmed with PCR. He had visited the ED previously with the same complaints and had been treated with antibiotics for a respiratory infection. The patient recovered after treatment with chloroquine and primaquine. The patient denied ever having traveled to a malarious area, IV drug use, or history of blood transfusion during the preceding 12 months. He reported fishing at a community pond in the evenings.
- **Case 6.** On August 25, a male aged 17 years was admitted to hospital B with an 8-day history of fever, chills, and headaches. A blood smear from August 26 identified *P. vivax*, which was later confirmed with PCR. Treatment was started with doxycycline, quinine, and primaquine, and the patient made a full recovery. The patient denied having ever traveled to a malarious area or using IV drugs and had no history of blood transfusion. He reported playing basketball outside around dusk at his house and spending time at a pond near the house.
- **Case 7.** On August 26, a man aged 48 years was admitted to hospital C with a 7-day history of fever and chills. He had self-treated earlier that week with antibiotics. A blood smear identified *P. vivax* on the day of admission, which was later confirmed with PCR. He recovered after treatment with chloroquine and primaquine. The patient denied blood transfusions or IV drug use during the preceding 12 months. He had resided in Colombia, but had last been there in 2001. The patient is a carpenter and works until 8 p.m. in an open warehouse.
- **Case 8.** On September 14, 2003, a man aged 27 years was admitted to hospital C after experiencing fever, nausea, and

vomiting. A blood smear identified *P. vivax*, which was later confirmed with PCR. He recovered after treatment with quinine, doxycycline, and primaquine. The patient was originally from Mexico, but had not traveled there in 5 years. He denied having had malaria since living in the United States, but was unsure of malaria infection before that time. He denied any history of blood transfusions during the preceding 12 months. The patient was a construction worker and was frequently outdoors.

Deaths Attributed to Malaria

Seven deaths attributable to malaria were reported in 2003 and are described in the following case reports:

- **Case 1.** On January 3, 2003, a female aged 57 years from Yemen who had arrived in the United States on December 30, 2002, went to a local outpatient clinic. She had complaints of right hip pain, headache, and loss of appetite for 2 days, nausea and vomiting for 2 weeks, and subjective fevers of unknown duration. She was neutropenic and sent to a local hospital ED. The patient had cervical cancer and had been treated with both radiation and chemotherapy, the most recent course of therapy on December 12, 2002. In the ED, the patient was afebrile, dehydrated, and had an absolute neutrophil count of 0.79 x 109 cells/L and a hemoglobin of 8.2 g/dL. The patient was admitted for further evaluation of her hip pain and for blood transfusion. The patient was transfused on January 1, 2003, and on January 5 the patient experienced a fever and was empirically started on ciprofloxacin and piperacillin/tazobactam. Urine and blood cultures did not demonstrate bacterial pathogens and chest radiograph did not show any indication of pneumonia. The patient experienced acute renal failure. On January 10, the patient's mental status deteriorated, and an infectious disease consultant recommended adding vancomycin and cefipime, checking a peripheral smear, and performing a lumbar puncture. The patient's mental status continued to deteriorate. She died later that day. Blood cultures later grew gram positive cocci in clusters, and the blood smear demonstrated *Plasmodium*, although no species was reported.
- **Case 2.** On April 1, 2003, a man aged 47 years in Florida went to his primary care physician with a 2-day history of fever, chills, vomiting, headache, low back pain, and myalgias and was referred to the ED. The patient had returned approximately 2 weeks prior from a 1-week vacation in rural Haiti where he had visited family. The patient's initial laboratory studies were significant for thrombocytopenia (115,000/uL), large numbers of immature leukocytes (31% bands), and hypoxemia (PO_2 60.9 mm/Hg). The patient's chest radiograph was normal. He was admitted with a presumptive diagnosis of pneumonia and started on intravenous ceftriaxone, azithromycin, and trimethoprim/sulfamethaxzole. On April 3, a peripheral blood smear demonstrated the presence of *P. falciparum* with a parasite density of 0.4%. The patient was started on oral chloroquine, and repeat blood smear on April 4 demonstrated a decreasing parasitemia (<0.1%). Nonetheless, the patient experienced shortness of breath with worsening hypoxemia and anemia (hemoglobin: 9.2 g/dL) and on April 5, was intubated and admitted to ICU on mechanical ventilation. The patient was transfused with PRBCs and fresh frozen plasma and continued on chloroquine and antibiotics. On April 8, the patient experienced asystole, and resuscitative efforts were unsuccessful.
- **Case 3.** On April 26, 2003, a man aged 67 years in Louisiana went to a local ED with complaints of fever and chills for 3 days. The patient had returned 13 days previously from a 2-week trip in Zimbabwe and reported taking chloroquine as prophylaxis. The patient was admitted for presumed malaria, and a peripheral blood smear demonstrated the presence of *P. falciparum* with a parasite density of 5%--10%. The patient was started on oral quinine and IV doxycycline. On hospital day 2, his parasitemia had dropped to 1%, but the patient had a focal seizure, became obtunded, and required endotracheal intubation with mechanical ventilation. His renal function deteriorated, necessitating dialysis, and the patient was switched to IV quinidine and doxycycline. The IV quinidine was discontinued on hospital day 3 because of EKG abnormalities, and the patient was switched to quinine by nasogastric tube. Vasopressors became necessary to maintain adequate systolic blood pressure. On hospital day 5, the patient had markedly elevated liver enzymes, fixed and dilated pupils, and an EEG revealing minimal activity although parasitemia had cleared. Later that day, the patient experienced cardiac arrest, and resuscitative measures were unsuccessful.
- **Case 4.** On October 29, 2003, a man aged 54 years in Florida went to a local hospital with mental confusion. The patient was visiting from England. He arrived in the United States in October of 2003, and previous travel history was unknown. The patient was anemic and confused and was admitted to the hospital. He died on November 11. Postmortem examination demonstrated the presence of *plasmodium* parasites. No species was identified.
- **Case 5.** On November 23, 2003, a man aged 40 years in Texas returned from a 16-day trip to Zambia. The patient had been prescribed chloroquine prophylaxis but only had taken a few doses. On the return flight home, the patient reported having fever, nausea, and myalgias, but did not seek medical care on arrival because the symptoms had dissipated. On December 5, the patient went to a local outpatient clinic with fever, chills, nausea, and vomiting, was sent home, and then went to an ED. At that time, he had fever but his physical examination was otherwise normal. A thin smear demonstrated plasmodium parasites, later determined to be *P. falciparum*, with a parasite density of 17%. Other laboratory abnormalities included a hemotocrit of 33%, creatinine of 3.6 mg/dL, and a total bilirubin of 11.0 mg/dL. The patient was admitted to ICU and

started on oral quinine and doxycycline. An exchange transfusion was planned. While preparing for the transfusion, the patient became hypotensive, requiring dopamine to maintain a systolic blood pressure between 60--70 mm/Hg. During the transfusion, the patient became increasingly tachypnic and experienced atrial flutter with worsening hypotension. Cardioversion was attempted, but the patient subsequently experienced asystole. Resuscitative efforts were unsuccessful, and the patient died 6 hours after admission.

- **Case 6.** On December 21, 2003, a man aged 56 years in Louisiana was brought to an ED by his family because he had a seizure and fever. The patient was an engineer and spent 28-day rotations in Nigeria. He had last returned on December 4 and was not taking prophylaxis. The patient experienced fever, cough, and myalgias before returning to the United States. On arrival, he began treating himself with over-the-counter medications. The patient did not seek medical care. The patient's symptoms worsened 2 days before admission, and he was found at home on December 21 unresponsive with urinary incontinence. On arrival at the ED, the patient was confused and afebrile. While in the ED, he experienced a fever (temperature of 103.9°F [40°C]) and had a seizure. *Plasmodium* parasites were identified on blood smear, but the species was not identified. Other laboratory abnormalities included leukocytosis with large numbers of immature neutrophils (white blood cell count: 16,000/uL, 38% bands), anemia (Hgb: 9.0 g/dL), thrombocytopenia (platelets: 49,000/uL), hyponatremia (sodium: 112 mmol/L), acute renal insufficiency (creatinine: 1.9 mg/dL), and hyperbilirubinemia (total bilirubin: 7.7 mg/dL). The patient was started on IV ceftriaxone, and oral doxycycline and quinine. The patient's condition deteriorated on hospital day 2, and repeat laboratory studies demonstrated a worsening anemia (Hgb: 7.1 g/dL), thrombocytopenia (platelets: 18,000/uL), and acidosis (pH: 6.7). The patient was switched to IV quinidine gluconate and transfused with 4 units of PRBCs but did not improve. Exchange transfusion was planned, but the patient died later that day.
- **Case 7.** On March 10, 2003, a man aged 57 years in Pennsylvania went to an ED with daily fevers, chills, fatigue, confusion, and myalgias. The symptoms began on February 19 when he returned from a 19-day vacation in Kenya and Tanzania. He reported taking mefloquine prophylaxis during the trip but stopped it 1 week after return. In the ED, he had a fever (103.5°F [39.5°C]), anemia (Hgb: 10.1 g/dL), mild hypotension, acute renal failure (creatinine: 2.0 mg/dL), and jaundice (total bilirubin: 4.2 mg/dL). His blood smear demonstrated *Plasmodium* parasites with high parasitemia, and he was transferred to another hospital for admission. A repeat blood smear at the admitting hospital confirmed the presence of malaria (parasite density 1.7% of RBCs infected), but no species was identified. The patient was started on IV quinidine gluconate. Despite therapy, the patient became more obtunded on hospital day 2, necessitating endotracheal intubation and mechanical ventilation. The patient experienced thrombocytopenia (platelets: 12,000/uL) with worsening renal and liver failure, and had fevers $\geq$106°F ($\geq$41°C). Repeat peripheral smear demonstrated a parasitemia of >10%. The patient underwent exchange transfusion. He did not improve and died on March 12.

Discussion

A total of 1,278 cases of malaria were reported to CDC for 2003, representing a 4.4% decrease from the 1,337 cases reported for 2002. This change primarily resulted from a decrease in cases acquired in Africa. Since 2000, CDC has routinely contacted state health departments to ask for outstanding malaria case reports from the previous reporting year or for a statement that reporting is complete. The decrease in cases in 2003, compared with 2002, most likely does not represent a true trend. Possible explanations for a decrease include decreased international travel or changing patterns of travel (e.g., decreased immigration from malarious areas).

One reason for conducting malaria surveillance is to monitor for prophylaxis failures that might indicate emergence of drug resistance; however, approximately 82.7% of imported malaria among U.S. civilians occurred among persons who were either not taking prophylaxis or were taking nonrecommended prophylaxis for the region to which they were traveling. Among patients for whom appropriate prophylaxis was reported and for whom adequate information was available about species and onset of symptoms to indicate that the infection was a primary one rather than a relapse, the majority reported noncompliance with recommended regimen or had insufficient information to determine whether these cases represented problems with adherence while using correct antimalarial chemoprophylaxis, malabsorption of the antimalarial drug, or emerging drug resistance. Among patients who reported compliance with a recommended regimen, serum drug levels were not available. Therefore, differentiating among inaccurate reporting of compliance, malabsorption of the antimalarial drug, and emerging drug resistance is impossible. No conclusive evidence existed to indicate a single national or regional source of infection among this group of patients or the failure of a particular chemoprophylactic regimen. Health-care providers should contact CDC rapidly whenever they suspect chemoprophylaxis failure, thus enabling measurement of serum drug levels of the antimalarial drugs in question.

The importance of taking correct precautions and chemoprophylaxis is underscored by the seven fatal cases of malaria that occurred in the United States in 2003. An earlier review of deaths attributed to malaria in the United States indicated that failure to take or adhere to recommended antimalarial chemoprophylaxis, to promptly seek medical care for posttravel illness, and to

promptly diagnose and treat suspected malaria all contributed to fatal outcomes (*11*).

The occurrence of 18 cases of malaria among pregnant U.S. civilians is also cause for concern. Malaria during pregnancy among nonimmune women is more likely to result in severe disease or contribute to an adverse outcome than malaria in nonpregnant women (*12*). In addition, the fetus might be adversely affected (*13*). Pregnant travelers should be counseled to avoid travel to malarious areas. If deferral of travel is impossible, pregnant women should be informed that the risks for malaria outweigh those associated with prophylaxis and that safe chemoprophylaxis regimens are available. Specific guidance for pregnant travelers is available at http://www.cdc.gov/travel/mal_preg_pub.htm.

The eight cases of introduced malaria in Florida demonstrate the potential for reintroduction of malaria into the United States. Of the 10 species of *Anopheles* mosquitoes found in the United States, the two species that were responsible for malaria transmission before eradication (*Anopheles quadrimaculatus* in the east and *An. freeborni* in the west) are still widely prevalent. Intensive surveillance, rapid recognition, accurate diagnosis, and appropriate case management are essential for limiting the spread of a malaria outbreak.

Signs and symptoms of malaria are often nonspecific, but fever is usually present. Other symptoms include headache, chills, increased sweating, back pain, myalgia, diarrhea, nausea, vomiting, and cough. Prompt diagnosis requires that malaria be included in the differential diagnosis of illness in a febrile person with a history of travel to a malarious area. Clinicians should ask all febrile patients for a travel history, including international visitors, immigrants, refugees, migrant laborers, and international travelers.

Prompt treatment of suspected malaria is essential because persons with *P. falciparum* infection are at risk for life-threatening complications soon after the onset of illness. Ideally, therapy for malaria should be initiated immediately after the diagnosis has been confirmed by a positive blood film. Treatment should be determined on the basis of the infecting *Plasmodium* species, the probable geographic origin of the parasite, the parasite density, and the patient's clinical status (*14*). If the diagnosis of malaria is suspected and cannot be confirmed, or if a diagnosis of malaria is confirmed but species determination is not possible, antimalarial treatment should be initiated that is effective against *P. falciparum*. Resistance of *P. falciparum* to chloroquine is worldwide, with the exception of a limited number of geographic regions (e.g., Central America). Therefore, therapy for presumed *P. falciparum* malaria should usually entail the use of a drug effective against such resistant strains.

Health-care providers should be familiar with prevention, recognition, and treatment of malaria and are encouraged to consult appropriate sources for malaria prevention and treatment recommendations (Table 7). Physicians seeking assistance with the diagnosis or treatment of patients with suspected or confirmed malaria should call CDC's National Center for Infectious Diseases, Division of Parasitic Diseases (770-488-7788) during regular business hours or the CDC's Emergency Operations Center (770-488-7100) during evenings, weekends, and holidays (ask to page person on call for Malaria Branch), or access CDC's Internet site at http://www.cdc.gov/malaria/diagnosis_treatment/treatment.htm. These resources are intended for use by health-care providers only.

Detailed recommendations for preventing malaria are available to the general public 24 hours a day from CDC by telephone (877-394-8747 [toll-free voice information system] or 888-232-3299 [toll-free facsimile request line]) or on the Internet (http://www.cdc.gov/travel/diseases.htm/malaria). In addition, CDC biannually publishes recommendations in *Health Information for International Travel* (commonly referred to as *The Yellow Book*) (*10*), which is available for purchase from the Public Health Foundation at 877-252-1200 or 301-645-7773; it is also available and updated more frequently on CDC's Internet site at http://www.cdc.gov/travel.

CDC provides technical support for health-care providers in the diagnosis of malaria through DPDx, a program that enhances diagnosis of parasitic diseases throughout the world. It includes an Internet site (http://www.dpd.cdc.gov/dpdx) that contains information about laboratory diagnosis, geographic distribution, clinical features, treatment, and life cycles of more than 100 different parasite species, including malaria parasites. The DPDx Internet site is also a portal for diagnostic assistance for health-care providers through telediagnosis. Digital images captured from diagnostic specimens are submitted for diagnostic consultation through e-mail. Because laboratories can transmit images to CDC and rapidly obtain answers to their inquiries, this system allows efficient diagnosis of difficult cases and rapid dissemination of information. Approximately 46 public health laboratories in 41 states, Puerto Rico, and Guam have or are in the process of acquiring the hardware to perform telediagnosis.

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* To obtain confirmation diagnosis of blood films from questionable cases and to obtain appropriate treatment recommendations, contact either your state or local health department or CDC's National Center for Infectious Diseases, Division of Parasitic Diseases, Malaria Branch at 770-488-7788.

Table 1

TABLE 1. Number of malaria cases* among U.S. and foreign civilians and U.S. military personnel — United States, 1973–2003

Year	U.S. military personnel	U.S. civilians	Foreign civilians	Status not recorded†	Total
1973	41	103	78	0	**222**
1974	21	158	144	0	**323**
1975	17	199	232	0	**448**
1976	5	178	227	5	**415**
1977	11	233	237	0	**481**
1978	31	270	315	0	**616**
1979	11	229	634	3	**877**
1980	26	303	1,534	1	**1,864**
1981	21	273	809	0	**1,103**
1982	8	348	574	0	**930**
1983	10	325	468	0	**803**
1984	24	360	632	0	**1,016**
1985	31	446	568	0	**1,045**
1986	35	410	646	0	**1,091**
1987	23	421	488	0	**932**
1988	33	550	440	0	**1,023**
1989	35	591	476	0	**1,102**
1990	36	558	504	0	**1,098**
1991	22	585	439	0	**1,046**
1992	29	394	481	6	**910**
1993	278	519	453	25	**1,275**
1994	38	524	370	82	**1,014**
1995	12	599	461	95	**1,167**
1996	32	618	636	106	**1,392**
1997	28	698	592	226	**1,544**
1998	22	636	361	208	**1,227**
1999	55	833	381	271	**1,540**
2000	46	827	354	175	**1,402**
2001	18	891	316	158	**1,383**
2002	33	849	272	183	**1,337**
2003	36	767	306	169	**1,278**

* A case was defined as symptomatic or asymptomatic illness that occurs in the United States in a person who has microscopy-confirmed malaria parasitemia, regardless of whether the person had previous attacks of malaria while in other countries. A subsequent attack of malaria occurring in a person is counted as an additional case if the demonstrated *Plasmodium* species differs from the initially identified species. A subsequent attack of malaria occurring in a person while in the United States could indicate a relapsing infection or treatment failure resulting from drug resistance if the demonstrated *Plasmodium* species is the same species identified previously.

† The increase in persons with unknown civil status that occurred in the 1990s might be attributed to a change in the surveillance form.

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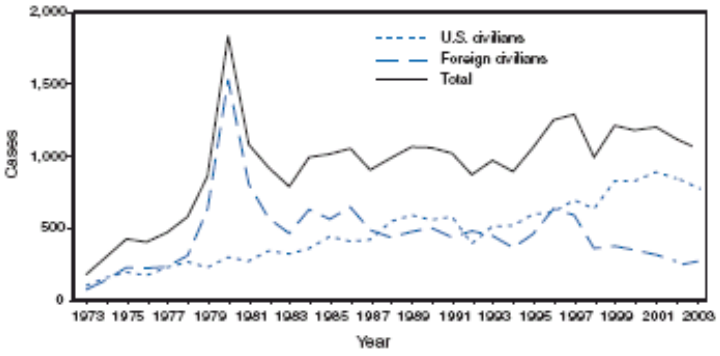
Figure 1

FIGURE 1. Number of malaria cases among U.S. and foreign civilains, by year — United States,* 1973–2003†



*Includes Puerto Rico, Guam, and the U.S. Virgin Islands.
†The substantial increase in the number of cases reported for 1980 primarily reflects cases diagnosed among immigrants from Southeast Asia.

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Table 2

TABLE 2. Number of malaria cases, by *Plasmodium* species — United States, 2001, 2002, and 2003

Plasmodium species	2001		2002		2003	
	No.	(%)	No.	(%)	No.	(%)
P. falciparum	693	(50.1)	699	(52.3)	682	(53.4)
P. vivax	385	(27.8)	339	(25.4)	293	(22.9)
P. malariae	62	(4.5)	38	(2.8)	46	(3.6)
P. ovale	50	(3.6)	37	(2.8)	33	(2.6)
Mixed	14	(1.0)	11	(0.8)	12	(0.9)
Undetermined	179	(12.9)	213	(15.9)	212	(16.6)
Total	**1,383**	**(100.0)**	**1,337**	**(100.0)**	**1,278**	**(100.0)**

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Figure 2

FIGURE 2. Number of malaria cases, by state in which the disease was diagnosed — United States, 2003

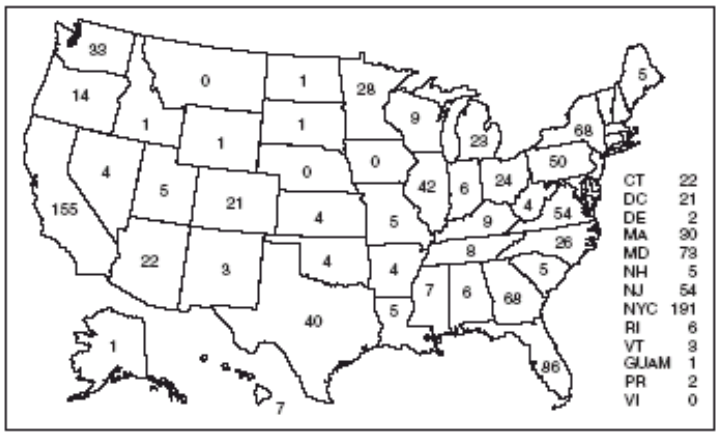

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Table 3

TABLE 3. Imported malaria cases, by country of acquisition and *Plasmodium* species — United States, 2003

Country of acquisition	*Plasmodium* species						
	P. falciparum	*P. vivax*	*P. malariae*	*P. ovale*	Unknown	Mixed	Total
Africa	**587**	**49**	**31**	**29**	**137**	**7**	**840**
Angola	2	0	0	0	1	0	3
Benin	1	0	0	0	0	1	2
Burkina Faso	2	0	0	0	0	0	2
Burundi	0	0	0	0	0	0	0
Cameroon	29	3	2	2	5	0	41
Central African Republic	1	0	0	0	0	0	1
Chad	2	0	0	0	0	0	2
Comoros	0	0	0	0	1	0	1
Congo	9	2	3	0	1	1	16
Cote d'Ivoire	16	0	0	1	1	0	18
Democratic Republic of Congo	1	0	0	0	0	0	1
Equatorial Guinea	2	0	0	0	1	0	3
Eritrea	0	1	0	0	0	0	1
Ethiopia	3	5	0	1	3	0	12
Gabon	2	0	0	0	0	1	3
Gambia	15	0	2	0	3	0	20
Ghana	93	4	4	2	18	1	122
Guinea	11	1	2	3	5	1	23
Kenya	37	8	1	3	10	0	59
Liberia	16	1	0	0	5	0	22
Malagasy Republic	1	0	0	0	0	0	1
Malawi	3	0	0	1	0	0	4
Mali	11	0	0	0	0	0	11
Mauritania	0	2	0	0	0	0	2
Morocco	1	0	0	0	0	0	1
Mozambique	4	0	1	0	0	0	5
Niger	3	0	0	0	1	0	4
Nigeria	182	6	5	6	39	2	240
Rwanda	0	0	0	0	0	0	0
Senegal	27	1	1	0	5	0	34
Sierra Leone	30	0	1	2	9	0	42
Somalia	1	0	0	0	0	0	1
South Africa	6	2	1	0	0	0	9
Sudan	2	2	0	0	2	0	6
Tanzania	4	1	1	0	2	0	8
Togo	4	0	0	0	1	0	5
Tunisia	0	0	0	0	0	0	0
Uganda	14	4	4	4	12	0	38
Zambia	4	0	0	0	0	0	4
Zimbabwe	4	0	0	0	0	0	4
West Africa, unspecified	15	0	1	2	3	0	21
Central Africa, unspecified	0	0	0	0	0	0	0
East Africa, unspecified	0	0	0	0	0	0	0
Africa, unspecified	29	6	2	2	9	0	48
Asia	**19**	**127**	**7**	**3**	**19**	**2**	**177**
Afghanistan	1	10	0	0	2	0	13
Cambodia	0	2	0	0	0	0	2
China	0	1	0	0	0	0	1
India	12	76	3	2	7	0	100
Indonesia	1	6	0	1	1	0	9
Iraq	0	7	0	0	1	0	8
Korea (South)	0	7	1	0	0	0	8
Lao PDR	1	0	0	0	0	0	1
Malaysia	0	0	0	0	1	0	1
Nepal	0	0	0	0	1	0	1
Pakistan	2	15	3	0	2	1	23
Philippines	0	0	0	0	1	0	1
Thailand	0	2	0	0	1	1	4
United Arab Emirates	0	0	0	0	0	0	0
Vietnam	1	1	0	0	0	0	2
Yemen	1	0	0	0	1	0	2
Asia, unspecified	0	0	0	0	0	0	0
Southeast Asia, unspecified	0	0	0	0	1	0	1

TABLE 3. (*Continued*) Imported malaria cases, by country of acquisition and *Plasmodium* species — United States, 2003

Country of acquisition	*Plasmodium* species						
	P. falciparum	*P. vivax*	*P. malariae*	*P. ovale*	Unknown	Mixed	Total
Central America and the Caribbean	**28**	**45**	**2**	**0**	**18**	**1**	**94**
Belize	0	1	0	0	0	0	1
Costa Rica	1	0	0	0	2	0	3
Dominican Republic	0	1	0	0	0	0	1
El Salvador	1	3	0	0	0	0	4
Guatemala	1	12	0	0	2	1	16
Haiti	17	1	0	0	5	0	23
Honduras	8	24	1	0	9	0	42
Nicaragua	0	1	1	0	0	0	2
Panama	0	1	0	0	0	0	1
Central America, unspecified	0	1	0	0	0	0	1
North America	**5**	**14**	**1**	**0**	**1**	**0**	**21**
Mexico	5	14	1	0	1	0	21
South America	**6**	**17**	**1**	**0**	**6**	**2**	**32**
Bolivia	0	0	0	0	1	0	1
Brazil	1	5	0	0	1	0	7
Ecuador	0	3	1	0	1	0	5
Guyana	3	3	0	0	0	1	7
Peru	2	4	0	0	1	1	8
Venezuela	0	0	0	0	1	0	1
South America, unspecified	0	2	0	0	1	0	3
Oceania	**2**	**24**	**3**	**1**	**7**	**0**	**37**
Marshall Islands	0	0	1	0	0	0	1
Papua New Guinea	2	20	1	0	6	0	29
Solomon Islands	0	1	0	0	0	0	1
Vanuatu	0	2	0	0	1	0	3
Oceania unspecified	0	1	1	1	0	0	3
Europe/Newly Independent States	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Unknown	**33**	**10**	**1**	**0**	**23**	**0**	**67**
Total	**680**	**286**	**46**	**33**	**211**	**12**	**1268**

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Table 4

TABLE 4. Number of imported malaria cases, by interval between date of arrival in the country and onset of illness and *Plasmodium* species* — United States, 2003

Interval (days)	*P. falciparum*		*P. vivax*		*P. malariae*		*P. ovale*		Mixed		Total	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
<<0†	59	(12.9)	15	(11.1)	1	(4.3)	0	0	2	(22.2)	**77**	**(12.0)**
0–29	363	(79.4)	57	(42.2)	13	(60.0)	6	(37.5)	4	(44.4)	**443**	**(69.2)**
30–89	28	(6.1)	27	(20.0)	4	(17.4)	3	(18.8)	1	(11.1)	**63**	**(9.8)**
90–179	2	(0.4)	19	(14.1)	4	(17.4)	4	(25.0)	2	(22.2)	**31**	**(4.8)**
180–364	2	(0.4)	16	(11.9)	1	(4.3)	2	(12.5)	0	0	**21**	**(3.3)**
≥365	3	(0.7)	1	(0.7)	0	0	1	(6.3)	0	0	**5**	**(0.8)**
Total	**457**	**(100.0)**	**135**	**(100.0)**	**23**	**(100.0)**	**16**	**(100.0)**	**9**	**(100.0)**	**640**	**(100.0)**

* Persons for whom *Plasmodium* species, date of arrival in the United States, or date of onset of illness is unknown are not included.
† Persons in these cases in this row are those with onset of illness before arriving in the United States.

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Table 5

TABLE 5. Number of imported malaria cases among U.S. and foreign civilians, by region of acquisition — United States, 2003*

Area or region	United States		Foreign		Total	
	No.	(%)	No.	(%)	No.	(%)
Africa	561	(73.7)	202	(66.2)	763	(71.6)
Asia	83	(10.9)	54	(17.7)	137	(12.9)
Central America and the Caribbean	59	(7.6)	24	(7.9)	83	(7.8)
South America	21	(2.8)	8	(2.6)	29	(2.7)
North America	6	(0.8)	12	(3.9)	18	(1.7)
Oceania	26	(3.4)	4	(1.1)	30	(2.8)
Europe/Newly Independent States	0	(0)	0	(0)	0	(0)
Unknown†	5	(0.7)	1	(0.3)	6	(0.6)
Total	**761**	**(100.0)**	**305**	**(100.0)**	**1,066**	**(100.0)**

* Persons for whom U.S. or foreign status is not known are excluded.
† Region of acquisition is unknown.

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Table 6

TABLE 6. Number of imported malaria cases among U.S. civilians, by purpose of travel at the time of acquisition* — United States, 2003

Category	Imported cases	
	No.	(%)
Visiting friends/relatives	422	(53.9)
Tourism	98	(12.5)
Missionary or dependent	72	(9.2)
Business representative	59	(7.5)
Student/teacher	30	(3.8)
Peace Corps volunteer	11	(1.4)
Refugee/immigrant	4	(0.5)
Air crew/sailor	2	(0.3)
Other	16	(2.0)
Unknown	69	(8.8)
Total	**783**	**(100.0)**

* In several cases, more than one purpose of travel was specified.

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Table 7

TABLE 7. Sources for malaria prophylaxis, diagnosis, and treatment recommendations

Type of information	Source	Availability	Telephone number, Internet address, or electronic-mail address
Prophylaxis	CDC's voice information system	24 hours/day	877-394-8747 (877-FYI-TRIP)
Prophylaxis	CDC's Traveler's Health fascimile information service	24 hours/day	888-232-3299
Prophylaxis	CDC's Traveler's Health internet site (includes online access to *Health Information for International Travel*)	24 hours/day	http://www.cdc.gov/travel
Prophylaxis	*Health Information for International Travel* (*The Yellow Book*)	Order from Public Health Publication Sales P.O. Box 753 Waldorf, MD 20604	877-252-1200 or 301-645-7773 or http://www.phf.org
Diagnosis	CDC's Division of Parasitic Diseases diagnostic Internet site (DPDx)	24 hours/day	http://www.dpd.cdc.gov/dpdx
Diagnosis	CDC's Division of Parasitic Diseases diagnostic CD-ROM (DPDx)	Order by electronic mail from CDC Division of Parasitic Diseases	dpdx@cdc.gov
Treatment*	CDC's Malaria Branch	8:00 am–4:30 pm Eastern Time, Monday–Friday	770-488-7788*
Treatment	CDC's Malaria Branch	4:30 pm–8:00 am Eastern Time, evenings, weekends, and holidays	770-488-7100* (This is the number for the CDC's Emergency Operations Center. Ask staff member to page person on call for Malaria Branch). http://www.cdc.gov/malaria/diagnosis_treatment/treatment.htm.

* These telephone numbers are intended for use by health-care professionals only.

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